

# Surgically-guided zygomatic and pterygoid implants— a no-grafting rehabilitation approach in severe atrophic maxilla—A case report

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## Abstract

### Introduction

This report discusses surgically-guided zygomatic and pterygoid implants.

### Case report

We present a case report of a successful surgical approach in extreme maxillary atrophy without bone grafting. Six osseointegrated dental implants were positively positioned exploiting the residual atrophic bone: two in the canine region, two zygomatic implants placed using the sinus slot approach and two in the pterygomaxillary region. The procedure used to identify the correct placement of the fixtures is of particular interest. A high-definition computed tomography scan had been taken purely for diagnostic purposes and this was used to make a stereolithographic model. The surgical approach was simulated and then carried out directly on a solid acrylic resin model. An extremely precise surgical template was then developed and used to transfer the surgical approach for positioning implants to real bone. The patient was already wearing a complete upper denture, and this was modified to become a temporary denture during the period of osseointegration.

No immediate loading was performed. Four months after surgery, the implants were loaded, and an excellent aesthetic and functional result was achieved with no increase in bone volume from bone grafts. The entire residual bone was used as an anchorage for the implants. The excellent results achieved demonstrate that zygomatic implants in association with other conservative and guided surgical approaches are a valid alternative to bone grafting in treating severe atrophic and edentulous maxillae.

### Conclusion

In this case report, the accurately planned surgery made the use of local anaesthesia with intravenous sedation possible.

### Introduction

Many different surgical techniques for rehabilitating atrophic maxillae with implants to support fixed or removable prosthodontics are described in the literature<sup>1-8</sup>.

Zygomatic implants (ZIs) were firstly introduced by Branemark<sup>12</sup> in 1998 to rehabilitate the masticatory and aesthetic functions in severe atrophied maxillae caused by trauma, congenital conditions, tumour resection or increased sinus pneumatization. Given the high success rate reported for ZI placement, this surgical technique can be considered as a valid alternative therapeutic approach to bone grafting and invasive surgery to restore function and improve the aesthetic results for patients with atrophic edentulous maxilla<sup>9-15,16</sup>.

The surgical approach consists of using the frontal part of the

zygomatic bone as an anchorage for ZI, with support from the maxillary palatal or alveolar bone, without any bone augmentation. This offers a more simplified treatment approach, a decrease in biological impact and a more comfortable post-surgical period for the patient thanks to a quicker recovery time.

In the Branemark's<sup>12</sup> classical approach, the ZI body is placed through the sinus<sup>11</sup>. The result is not always optimal and does not provide sufficient primary stability because the intrasinus path of the ZI body does not exploit all the sinus bone available. During the post-surgical period, sinusitis may occur due to the position of the implant through the sinus<sup>17</sup>.

Furthermore, problems concerning an excessive angulation of the palatal emergence of the ZI head can occur in patients with atrophy and with accentuated buccal concavities on the lateral wall of the maxillary sinus, with problematic prosthetic consequences not easy to manage<sup>3,18-23</sup>.

Since Branemark<sup>12</sup>, new procedures and improvements have been developed to eliminate or reduce these problems, to preserve the integrity of the Schneider membrane and increase the fixture's stability ('sinus slot approach' introduced by Stella and Warner in 2000)<sup>24</sup>. More bone is used as an anchorage, and the primary stability is greater.

The sinus slot used to place the ZI is a guided window made through the buttress wall of the maxilla (i.e. a small antrostomy); the ZI is

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always directly visible. The implant axis is consequently more vertical, and a better buccal emergence of the implant is obtained. Also the implant head is better aligned with the maxillary arch and the resultant prosthesis is more comfortable to build.

This anatomical dissection, smaller than that of the Branemark<sup>12</sup> approach, accelerates post-surgical recovery time and reduces related oedema and ecchymosis<sup>10,24–32</sup>.

Migliorança et al.<sup>33,34</sup> described the exteriorised or extramaxillary approach, where no antrostomy is needed. For patients with extremely pronounced buccal concavity, the exteriorised approach is a good alternative for oral rehabilitation. It is a less invasive surgical procedure than the slot approach and the original Branemark<sup>12</sup> protocol, the surgery time is reduced and the emergence of the implant head is close to the residual alveolar crest<sup>19,33–36</sup>.

Using these last two approaches, the risk of causing sinusitis is significantly reduced because the sinus membrane is not damaged, there is a greater bone-to-implant contact and anchorage, the emergence of the implant head allows a better designed prosthesis and appropriate oral hygiene maintenance<sup>3,15,24,25,26,33,37,38</sup>.

Immediate provisional loading or a properly reconditioned removable prosthesis can be used during the period of osseointegration. Prosthetic loading of the implants is usually performed 4–6 months after surgery.

Depending on the anatomical conditions and intermaxillary occlusal profile, the prosthetic rehabilitation can be carried out through joint prosthesis, screwed prosthesis or conventional fixed prosthesis. The aim of this report was to discuss the no-grafting rehabilitation approach in severe atrophic maxilla in surgically-guided zygomatic and pterygoid implants.

### Case report

A 75-year-old Caucasian male patient with total edentulous maxilla required fixed implant-prosthetic rehabilitation on mandibular implants. He had no history of pathologies that could contraindicate surgery. A trial orthopantomography was carried out and subsequently a high-definition CT scan of the facial bones confirmed the severe atrophy of the maxilla. There was no sinus inflammation.

On the CT scan, a stereolithographic model of the facial bones was created and used to simulate the surgical intervention, physically placing two implants in the planned beds: canine pillars, ZIs emerging in the pre-molar distal region and pterygoid. Given the severe anatomic concavity of the anterior wall of the maxillary sinus, especially of the left side, it was decided to position ZIs with a technical slot procedure (Figures 1–3).



**Figure 1:** Frontal view of stereolithographic model.



**Figure 2:** Palatal view of stereolithographic model and the surgical guide on the right.

The next planned step was the construction of a surgical template to guide the optimal position and inclination of the implants in the patient's bone.

The implants measurements were decided and verified on the model: Medentis 4.8 diameter × 45 mm bilaterally for ZI, with an inclination of the stump of 40–45°, 4.1 × 15 mm for the pterygoid implants and the canine pillars.

The surgery is performed under local anaesthesia (2% Carbocaine with vasoconstrictor) with intravenous conscious sedation (Midazolam) after antibiotic prophylaxis with amoxicillin and clavulanic acid (2 g) two hours before surgery.

A slightly palatal incision is made in the maxillary crest with a bilateral vertical posterior releasing incisions (like Le Fort I exposure). A mucoperiosteal flap is reflected to expose the alveolar crest, the piriform opening,



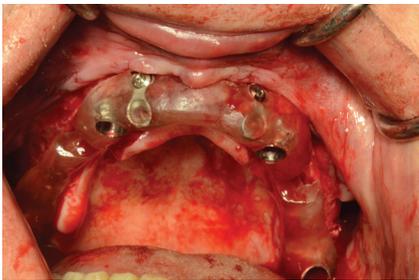
**Figure 3:** Stereolithographic model with zygomatic implant inserted.

the central and posterior part of the zygomatic complex, the infraorbital nerve emergence and the lateral wall of the maxillary sinus. The retractor is then placed to separate the cheek, to guide the osteotomy and to protect the soft tissue from drilling. The compression of the infraorbital nerve with retractor must be avoided as the invasion of the orbit. The hard palate is minimally prepared.

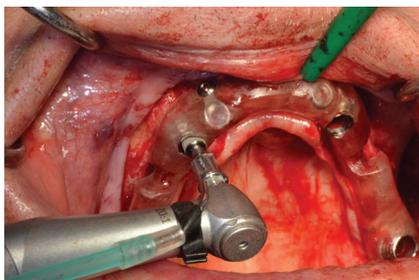
The surgical template is positioned and screwed to the premaxilla with two bone screws 9 mm long and 2 mm in diameter (Figure 4).

Implant sites are prepared and guided positioning of the pterygoid and canine implants is performed (Figure 5).

Corticotomy of the anterolateral wall of the maxillary sinus according to the slot technique is performed. The inclination of the slot on the anterolateral wall of the maxillary sinus is pre-determined by the surgical template and the antrostomy



**Figure 4:** The surgical template is then positioned and screwed to the premaxilla with two bone screws 9 mm long and 2 mm in diameter.

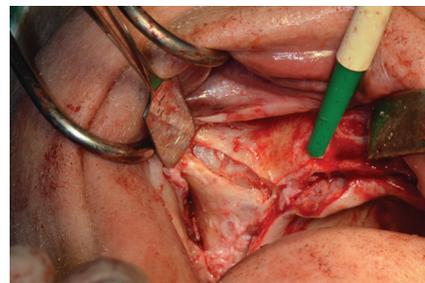


**Figure 5:** The canine implant is placed with the surgical template.

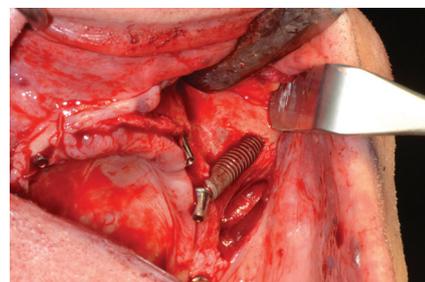
is performed with a diamond ball drill with a progressive diameter preserving and slightly detaching the sinus membrane.

Following the inclination predisposed by the slot, the ZI beds are prepared under visual control using progressive-diameter drills with extra-oral access and alveolar zygomatic arch direction. The implants are then screwed in place with a manual screwdriver (Figures 6–7).

The definitive prosthesis is screwed using preformed abutments, tilted at an angle of 0° for canine



**Figure 6:** The sinus slot is made with no damage of the sinus membrane.



**Figure 7:** A view of the zygomatic implants placed in the left sinus slot.

pillars, 20° and 40° for pterygoid and zygomatic implants respectively.

Haemostasis control, followed by suturing of the surgical field.

Adjustment of the temporary prosthesis.

Four months after surgery, an imprint is made using appropriate components and a fixed screw prosthesis is produced (Figures 8–10).

### Discussion

If on the one hand, procedures to increase the amount of bone for



**Figure 8:** Frontal view of the final prosthesis.



**Figure 9:** A palatal view of the final prosthesis.



**Figure 10:** Post-surgical OPT.

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subsequent implant-prosthetic rehabilitation of patients with severe atrophy guarantee good long-term results, on the other hand they inevitably increase the overall morbidity of treatment, especially in concomitance with important extra-oral bone withdrawals. Even using alternative biomaterials, such as bone from a bone bank<sup>39</sup>, these are high-impact interventions, especially if we consider the often advanced age of the patients that request this treatment. Moreover, in the case of fixed implants, management of the long period of healing required for the implant before loading is the cause of severe discomfort in those patients who are unable to use even a temporary prosthesis.

Given the current socio-economic difficulties, in clinical practice it is becoming increasingly common for patients to demand therapies that offer a good final result while at the same time reduce costs, healing time and the temporary inability to work, as is the case with major reconstructive surgeries with extra-oral withdrawals. It is, therefore, understandable that over the last decade, given the excellent results achieved, the use of ZIs has gradually established itself as a reliable procedure, offering good long-term results, and to be considered also as a rehabilitation treatment of atrophic maxilla in the context of post-trauma, post-cancer and serious malformations.

If the intrasinus path for the ZI is not used, the Schneider membrane is respected, the bone anchorage is increased and the post-surgical rhinosinusitis are reduced.

The guided anatomical positioning of the implants facilitates the subsequent prosthetic both in the distribution of occlusal loads, and in hygiene and functional management.

Surgery is usually planned through a digital simulation and surgical templates created are then used to carry out the intervention.

This case report is particularly interesting given that the surgery

was completely planned and realised on a real stereolithographic resin model of the jaw, without the use of any computer-aided simulation. It was firstly performed at the workbench and then transferred to the patient, using a surgical template produced to allow the guided positioning of the pterygoid and canine implant, and to identify the location and inclination of the ZIs. This, in our opinion, is more precise than the digital projections currently in use, especially if we consider the hypothesis of guided surgery with mucosa-supported templates. The size of the implants was measured directly. According to the original protocols, the surgery was carried out under general anaesthesia with nasal intubation.

### Conclusion

In this case report, the accurately planned surgery made the use of local anaesthesia with intravenous sedation possible. The surgical time is consequently shorter.

We are continuing our research and are now testing a system that allows ZIs to be positioned under a completely guided approach using the slot technique.

### Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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### References

1. Calandriello R, Tomatis M. Simplified treatment of the atrophic posterior maxilla via immediate/early function and tilted implants: a prospective 1-year clinical study. *Clin Implant Dent Relat Res.* 2005;7(Suppl 1):S1–12.

2. Balshi TJ, Wolfinger GJ, Balshi SF II. Analysis of 356 pterygomaxillary implants in edentulous arches for fixed prosthesis anchorage. *Int J Oral Maxillofac Implants.* 1999 May–Jun;14(3):398–406.
3. Becktor JP, Isaksson S, Abrahamsson P, Sennerby L. Evaluation of 31 zygomatic implants and 74 regular dental implants used in 16 patients for prosthetic reconstruction of the atrophic maxilla with cross-arch fixed bridges. *Clin Implant Dent Relat Res.* 2005;7(3):159–65.
4. Kahnberg KE, Ekestubbe A, Grondahl K, Nilsson P, Hirsch JM. Sinus lifting procedure. I. One-stage surgery with bone transplant and implants. *Clin Oral Implants Res.* 2001 Oct;12(5):479–87.
5. Maló P, de Araújo NM, Rangert B. Short implants placed one-stage in maxillae and mandibles: a retrospective clinical study with 1 to 9 years of follow-up. *Clin Implant Dent Relat Res.* 2007 Mar;9(1):15–21.
6. Langer B, Langer L, Herrmann I, Jorneus L. The wide fixture: a solution for special bone situations and a rescue for the compromised implant. *Int J Oral Maxillofac Implants.* 1993;8(4):400–8.
7. Reichert TE, Kunkel M, Wahlmann U, Wagner W. Das Zygoma-Implantat—Indikationen und erste klinische Erfahrungen. *Z Zahnärztl Implantol.* 1999;15:65–70.
8. Boyes-Varley JG, Howes DG, Lownie JF. The zygomaticus implant protocol in the treatment of the severely resorbed maxilla. *SADJ.* 2003 Apr;58(3):106–9, 113–4.
9. NobelBiocare. Branemark system®—zygoma implant placement & prosthetic procedure.
10. Peñarrocha M, García B, Martí E, Boronat A. Rehabilitation of severely atrophic maxillae with fixed implant-supported prostheses using zygomatic implants placed using the sinus slot technique: clinical report on a series of 21 patients. *Int J Oral Maxillofac Implants.* 2007 Jul–Aug;22(4):645–50.
11. Brånemark PI, Grondahl K, Öhrnell LO, Nilsson P, Petruson B, Svensson B, et al. Zygoma fixture in the management of advanced atrophy of the maxilla: technique and long-term results. *Scand J Plast Reconstr Surg Hand Surg.* 2004;38(2):70–85.
12. Branemark PI. Surgery and fixture installation: zygomaticus fixture clinical procedures. 1st ed. Göteborg: Nobel Biocare AB; 1998.p1.

13. Aparicio C, Ouazzani W, Hatano N. The use of zygomatic implants for prosthetic rehabilitation of the severely resorbed maxilla. *Periodontol* 2000. 2008;47:162–71.
14. Palmer RM. Implant failure is higher in grafted edentulous maxillae. *J Evid Based Dental Pract*. 2005 Mar;5(1):16–8.
15. Stiévenart M, Malevez C. Rehabilitation of totally atrophied maxilla by means of four zygomatic implants and fixed prosthesis: a 6-40 months follow-up. *Int J Oral Maxillofac Surg*. 2010 Apr;39(4):358–63.
16. Aparicio C, Manresa C, Francisco K, Ouazzani W, Claros P, Potau JM. The long-term use of zygomatic implants: a 10-year clinical and radiographic report. *Clin Implant Dent Relat Res*. 2012 Oct.
17. Aparicio C, Manresa C, Francisco K, Aparicio A, Nunes J, Claros P, et al. Zygomatic implants placed using the zygomatic anatomy-guided approach versus the classical technique: a proposed system to report rhinosinusitis diagnosis. *Clin Implant Dent Relat Res*. 2013 Mar.
18. Davo R. Sinus reaction to zygomatic implants. In: Aparicio C, editor. *Zygomatic implants. The anatomy-guided approach*. Berlin: Ed. Quintessence; 2012. p59–78.
19. Aparicio C, Ouazzani W, Aparicio A, Fortes V, Muela R, Pascual A, et al. Extrasinus zygomatic implants: three year experience from a new surgical approach for patients with pronounced buccal concavities in the edentulous maxilla. *Clin Implant Dent Relat Res*. 2010 Mar;12(1):55–61.
20. Bedrossian E. Rehabilitation of the edentulous maxilla with the zygoma concept: a 7-year prospective study. *Int J Oral Maxillofac Implants*. 2010 Nov-Dec;25(6):1213–21.
21. Al-Nawas B, Wegener J, Bender C, Wagner W. Clinical soft tissue parameters of the zygomatic implant. *J Clin Periodontol*. 2004 Jul;31(7):497–500.
22. Boyes-Varley JG, Howes DG, Lownie JF, Blackbeard GA. Surgical modifications to the Branemark zygomaticus protocol in the treatment of the severely resorbed maxilla: a clinical report. *Int J Oral Maxillofac Implants*. 2003 Mar-Apr;18(2):232–7.
23. Farzad P, Andersson L, Gunnarsson S, Johansson B. Rehabilitation of severely resorbed maxillae with zygomatic implants: an evaluation of implant stability, tissue conditions, and patients' opinion before and after treatment. *Int J Oral Maxillofac Implants*. 2006 May-Jun;21(3):399–404.
24. Stella JP, Warner MR. Sinus slot technique for simplification and improved orientation of zygomaticus dental implants: a technical note. *Int J Oral Maxillofac Implants*. 2000 Nov-Dec;15(6):889–93.
25. Davó R, Malevez C, Rojas J, Rodríguez J, Regolf J. Clinical outcome of 42 patients treated with 81 immediately loaded zygomatic implants: a 12- to 42-month retrospective study. *Eur J Oral Implantol*. 2008 Summer;1(2):141–50.
26. Ferrara ED, Stella JP. Restoration of the edentulous maxilla: the case for the zygomatic implants. *J Oral Maxillofac Surg*. 2004 Nov;62(11):1418–22.
27. Peñarrocha M, Uribe R, García B, Martí E. Zygomatic implants using the sinus slot technique: clinical report of a patient series. *Int J Oral Maxillofac Implants*. 2005 Sep-Oct;20(5):788–92.
28. Aparicio C, Ouazzani W, Garcia R, Arevalo X, Muela R, Fortes V. A prospective clinical study on titanium implants in the zygomatic arch for prosthetic rehabilitation of the atrophic edentulous maxilla with a follow-up of 6 months to 5 years. *Clin Implant Dent Relat Res*. 2006;8(3):114–22.
29. Duarte LR, Filho HN, Francischone CE, Peredo LG, Branemark PI. The establishment of a protocol for the total rehabilitation of atrophic maxillae employing four zygomatic fixtures in an immediate loading system a 30-month clinical and radiographic follow-up. *Clin Implant Dent Relat Res*. 2007 Dec;9(4):186–96.
30. Bedrossian E, Rangert B, Stumpel L, Indresano T. Immediate function with the zygomatic implant: a graftless solution for the patient with mild to advanced atrophy of the maxilla. *Int J Oral Maxillofac Implants*. 2006 Nov-Dec;21(6):937–42.
31. Chow J, Hui E, Lee PK, Li W. Zygomatic implants protocol for immediate occlusal loading: a preliminary report. *J Oral Maxillofac Surg*. 2006 May;64(5):804–11.
32. Davo R, Malevez C, Rojas J. Immediate function in the atrophic maxilla using zygoma implants: a preliminary study. *J Prosthet Dent*. 2007 Jun;97(Suppl 6):S44–51.
33. Migliorança RM, Coppede A, Dias Rezende RC, de Mayo T. Restoration of the edentulous maxilla using extrasinus zygomatic implants combined with anterior conventional implants: a retrospective study. *Int J Oral Maxillofac Implants*. 2011 May-Jun;26(3):665–72.
34. Migliorança R, Ilg JP, Serrano AS, Souza RP, Zamperlini MS. Sinus exteriorization of the zygoma fixtures: a new surgical protocol. *Implant News*. 2006;3:30–5. Portuguese.
35. Maló P, Nobre Mde A, Lopes I. A new approach to rehabilitate the severely atrophic maxilla using extramaxillary anchored implants in immediate function: a pilot study. *J Prosthet Dent*. 2008 Nov;100(5):354–66.
36. Chow J, Wat P, Hui E, Lee P, Li W. A new method to eliminate the risk of maxillary sinusitis with zygomatic implants. *Int J Oral Maxillofac Implants*. 2010 Nov-Dec;25(6):1233–40.
37. Watzinger F, Birkfellner W, Wanschitz F, Ziya F, Wagner A, Kremser J, et al. Placement of endosteal implants in the zygoma after maxillectomy: a cadaver study using surgical navigation. *Plast Reconstr Surg*. 2001 Mar;107(3):659–67.
38. Xiaojun C, Ming Y, Yanping L, Yiqun W, Chengtao W. Image guided oral implantology and its application in the placement of zygoma implants. *Comput Methods Programs Biomed*. 2009 Feb;93(2):162–73.
39. Grecchi F, Zollino I, Parafioriti A, Mineo G, Pricolo A, Carinci F. One-step oral rehabilitation by means of implants' insertion, Le Fort I, grafts, and immediate loading. *J Craniofac Surg*. 2009 Nov;20(6):2205–10.